

show a beneficial effect of any pharmacologic treatment of human spinal cord injury.

This work is encouraging, but in the past few years, a methodical search for agents that counteract the known effects of ischemia has provided compounds with more specific actions than corticosteroids. These agents are under extensive investigation using *in vitro* and *in vivo* trials in animals. The two types of compounds studied, NMDA-receptor antagonists and calpain inhibitors, act at different levels of the calcium cascade and may be synergistic. Other compounds have been developed to counteract the detrimental by-products of lipid peroxidation. Thus, specific components of the cell derangement can be pharmacologically manipulated.

In the future, patients with spinal cord injury may be treated like those with myocardial infarction. Once the injury has occurred, rapid transfer to a specialized center with experience in the medical and surgical treatment of spinal cord injury will be standard. As the molecular nature of spinal cord injury becomes unraveled, compounds (or combinations of compounds) will be designed to counteract different levels of the ischemic cascade. This may prove extremely valuable in preserving neurologic function.

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Ilizarov Method

THE ILIZAROV METHOD is a technique that helps provide alternative solutions to some difficult orthopedic problems, including pseudarthroses, bone defects, angular and rotatory deformities, osteomyelitis, the correction of limb-length inequalities, enlargement of bones, lengthening of amputation stumps, arthrodeses of joints, and the management of open and closed fractures. The method has introduced a set of biologic principles that have recently been recognized and that require continued study.

Ilizarov's concept of "tension stress" posits that gradual controlled distraction stimulates bone production and neogenesis. When a distraction force is applied, tissue fibers and cells become oriented in the same direction as the distraction vector. This is said to mimic the process of natural growth. Certain factors are required for optimal bone regeneration. Stable fixation is necessary and is obtained with the Ilizarov apparatus. The rate and rhythm of distraction are also critical. The maximal rate at which the body can regenerate tissue is 0.25 mm four times a day for an overall rate of 1 mm a day. Unlike the Wagner technique, this gentle distraction allows bone to form without the need for supplemental bone grafting and internal fixation.

The Ilizarov apparatus comprises wires, fixation bolts, rings, threaded rods, hinges, and plates. These components allow the construction of more than 800 assemblies. The

apparatus from a biomechanical aspect is stiff for bending and torsion but less stiff for axial loading, which is thought to help promote osteogenesis.

Preoperative planning is essential to apply the Ilizarov method successfully. Careful attention to "safe zones" during wire insertion is important to prevent damage to vital nerves and blood vessels. Placing the involved muscle compartment on stretch during wire insertion minimizes contractures. Careful attention is also required to adjust the skin so that there is no tension on the skin-wire interface. The wires are then fixed and tension applied to rings that are in turn connected by threaded rods. The Ilizarov frame can be constructed in a way that will allow the appropriate correction of the deformity or lengthening.

For bone lengthening, a corticotomy is made in the metaphyseal region. This is a low-energy osteotomy that preserves the periosteal envelope. A latency period is required postoperatively before distraction. New bone should be seen within three to four weeks once the distraction has begun. Once the correct length is obtained or angular deformity corrected, the apparatus remains in place until the consolidation phase has been completed. During the postoperative period, frequent visits are often required to adjust or modify the assembly. Once the goal has been achieved, the apparatus is removed on an inpatient or outpatient basis.

Special postoperative considerations are important, especially because the apparatus may be in place for as long as a year. Pain tends to be mild to moderate, but its duration may make management a challenge. Intensive physical therapy and splinting techniques are used to prevent flexion contractures of the surrounding joints. Psychological support and family counseling are key elements to successful treatment.

Postoperative problems can include pin-track infections, premature or delayed consolidation, joint contractures, and pin breakage that may require replacement.

The Ilizarov method provides orthopedic surgeons with another tool to manage difficult problems. It is complex yet provides hope for some patients. Its use should be reserved for centers with extensive experience in pediatric or reconstructive orthopedics until more data are available regarding techniques, complications, and results.

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Update on the Diagnosis and Treatment of Scaphoid Fractures

THE SCAPHOID SERVES as an important mechanical link between the proximal and distal rows of carpal bones. Nonunion or malunion following its fracture allows malalignment of the carpal bones among themselves and against the radius. This predisposes to degenerative arthritis. Changes develop insidiously but predictably 10 to 20 years later. This accounts for the emphasis being placed on precise anatomic healing of the scaphoid. Only then can normal mechanics of the wrist be restored and late degenerative changes be avoided.